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13. ABSTRACT *(Maximum 200 words)*
The transport properties of carriers in the inversion layer was studied by using the thick-gate uniform channel field MOS transistor. Using devices with sub-100nm channel lengths, we performed an extensive investigation of ballistic transport in inversion layer under uniform field condition. We experimentally address the effect of a wide range of parameters on the high-field transport of inversion layer electrons and holes. Our findings point to electron velocity overshoot at room temperature, dependence of electron and hole saturation velocities on nitridation of the gate oxide, dependence of the high-field drift velocity on the effective vertical field, and relative insensitivity of electron and hole mobility and saturation velocity to moderate surface roughness.

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JOINT SERVICES ELECTRONICS PROGRAM

FINAL TECHNICAL REPORT

Contract F49620-94-0388
(1 July 1994-30 June 1997)

Joint Service Electronics Program

Principal Investigator: Jeffrey Bokor

Electronics Research Laboratory

University Of California, Berkeley

September 1997

1. OVERVIEW

The transport properties of carriers in the inversion layer was studied by using the thick-gate uniform channel field MOS transistor. Using devices with sub-100nm channel lengths, we performed an extensive investigation of ballistic transport in inversion layer under uniform field condition. We experimentally address the effect of a wide range of parameters on the high-field transport of inversion layer electrons and holes. Our findings point to electron velocity overshoot at room temperature, dependence of electron and hole saturation velocities on nitridation of the gate oxide, dependence of the high-field drift velocity on the effective vertical field, and relative insensitivity of electron and hole mobility and saturation velocity to moderate surface roughness.

The new quantitive data were used to calibrate a commercial device simulator, MEDICI. The calibrated simulator was further used to predict the impact of velocity overshoot on future MOSFETs. 20% current improvements is predicted for 0.1μm MOSFETs.

The objective is to directly measure electron and hole velocity versus electric field in structures as short as 1000A and in nearly uniform field at both 300 and 80 K. The results will be the first direct observations of velocity overshoot in silicon. We will use these data to calibrate existing Monte Carlo or energy-transport device simulators in collaboration with others.

This augmentation project has ended on July 31, 1997. We reported the results of a comprehensive experimental study of electron and hole velocity overshoot in MOSFET inversion layers [1,2]. These results were used to calibrate a widely used device simulator MEDICI [3], therefore, the entire semiconductor industry can reap the benefit of this research project.

2. PRINCIPLE INVESTIGATORS

Professors. Jeffrey Bokor and Chenming Hu
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3. DEGREES AWARDED

None

4. PUBLICATIONS

[1] F. Assaderaghi, D. Sinitsky, J. Bokor, P.K. Ko, H. Gaw, and C. Hu, "High-Field Transport of Inversion-Layer Electrons and Holes Including Velocity Overshoot," IEEE Trans on Electron Devices, vol. 44, No. 4, pp. 664-671, april, 1997.
[2] D. Sinitsky, F. Assaderaghi, C. Hu, and J. Bokor, "High Field Hole Velocity and Velocity Overshoot in Silicon Inversion Layers," IEEE Electron Device Letters, vol. 18, no. 2, pp. 54-56, February 1997.
[3] D. Sinitsky, et al, "Impact of Velocity Overshoot on Deep Submicron MOSFETs," submitted to IEEE Electron Device Letters.

5. LISTINGS OF REPORTABLE INVENTIONS

None